The Glasgow Naturalist (2014) Volume 26, Part 1, 63-68

Observations on a population of adders, slow-worms and common lizards on Loch Lomondside, Scotland

Christopher J. McInerny

School of Life Sciences, University of Glasgow, Glasgow G12 8QQ.

E-mail: Chris.McInerny@glasgow.ac.uk

ABSTRACT

A population of reptiles on the east shore of Loch Lomond, Scotland, was monitored intensively during 2012, to understand population numbers, distribution, movements and biology through the year. Numbers of European adders *Vipera berus,* slow-worms *Anguis fragilis* and common lizards *Zootoca vivipara* were detected. Animals were seen first emerging from hibernation in early March and watched until late October, with breeding biology and movements observed.

INTRODUCTION

Three species of reptile are native to Scotland, the European adder, slow-worm and common lizard, although a small, introduced population of sand lizards *Lacerta agilis* is present on Coll (Beebee and Griffiths, 2000), and there have been a few isolated observations of grass snakes *Natrix natrix* in southwest Scotland in the past and during the 2000s (Taylor, 1900; CARG, 2013).

All three native species are currently found throughout much of the country in suitable habitat, apart from Shetland, Orkney and the Outer Hebrides, although their distribution is patchy, being heavily influenced by human activities (Arnold, 1996; Reading et al 1996). The southwest of Scotland is a stronghold with the three reptiles present widely in Dumfries & Galloway, Ayrshire, Argyll and the Clyde areas, including some islands. Despite this little has been published describing the biology of these species in Scotland. Slow-worms have been studied on Ailsa Craig (McWilliam, 1925; Zonfrillo, 2000; Lavery *et al.*, 2004), and a few books and papers contain some interesting anecdotal information on slow-worms, adders and common lizards (White, 1877; Boulenger, 1892; Campbell, 1892; Dobbie, 1898a; Dobbie, 1898b; J.A. Harvie-Brown faunal series; Hinxman, 1902; Leighton, 1902; Service, 1902a; Service, 1902b; Morrison, 1924), with one containing details about Loch Lomond (Bidie, 1902). But there are no published studies based on intensive observations as have been completed elsewhere in the UK and Europe (Avery, 1962; Viitanen, 1967; Prestt, 1971; Stumpel 1985; Neumeyer, 1987; Stafford, 1987; Smith, 1990; Riddell, 1996; Platenberg and Griffiths, 1999; Anderssen, 2003; Phelps, 2004a; Phelps 2004b; McPhail, 2011).

Hence, I decided to monitor a rich population of the three species on Loch Lomondside to gain information about their biology in a Scottish context. Reptiles had been observed occasionally at this site for many years, with the author seeing a few in 2011. But the size of the population was not appreciated until systematic fieldwork was completed during 2012; this paper describes the results of these studies.

METHODS

Study site

The study site is an area of south and west facing replanted native forest on hills flanking the east shore of Loch Lomond, at an altitude of 40-90 m; in total it comprises some 50 hectares. The habitat consists of a mosaic of birch *Betula* spp, rowan *Sorbus* spp and oak *Quercus* spp, interspersed with bracken *Pteridium* spp, gorse *Ulex* spp, bramble *Rubus fruticosus,* heather *Calluna vulgaris,* and other native plants. The site is fenced preventing the entry of deer, and is consequently rich in native fauna and flora. It contains areas of exposed granite and mica schist rock, slopes and boggy areas, with a burn along its northern edge. The lower parts were once a sheep-farm. Many original stonewalls have collapsed, which have subsequently been grown over by bracken, bramble and gorse; these piles of covered rocks have created hibernacula suitable for reptiles. An area near to the farm buildings, particularly good for reptiles, is illustrated in Fig. 1.

Survey work

With the permission of the landowners up to 30 artificial refugia, made from roof matting, were placed at suitable places throughout the site on 11 March 2012, following ARG procedures (http://www.arguk.org/recording), with each refugium numbered and its position identified with a global positioning system (GPS) device. These were inspected visually about once a week through

most of the year until late October, typically from 8-10 am on sunny or warm days, though sometimes later if dictated by the weather. Weather conditions and air temperature were recorded on each visit.
The number, approximate age (based on size), and the gender of adders, slow-worms and common lizards was noted at, and in the vicinity of, each mat, by visual inspection. The gender of adders can be determined by their background colour, with males grey and females brown; female slow-worms have dark flanks and a dorsal line, with males a more uniform colour; male lizards are distinguished from females by brighter belly colours, a vertebral line made up of spots as opposed to a line, a larger head and swelling around the base of the tail (Beebee and Griffiths, 2000).

Individual adders were recognised through a combination of photographs of head patterns, which are unique to each individual (Sheldon and Bradley, 1989; Benson, 1999; Garbett, 2008; Sheldon and Bradley, 2011), and by repeated observations of individuals at sunning locations; this allowed actual numbers to be estimated. In contrast, actual numbers of slow-worms and common lizards were not estimated, as it was often found to be not possible to identify individuals from visual inspection; published methods require handling (Riddell, 1996), which was not attempted. These, instead, were counted as total observed counts, so-called "reptile days". Additionally, the locations of hibernacula and regular sunning positions were mapped.

RESULTS

Population numbers

The combined results of the survey work during 2012 are shown in Table 1 and Fig. 1. These show the numbers of reptiles seen during the year, and the distribution of reptiles at one part of the survey area, which had the highest density of animals. In total 40 individual adders were counted: 15 males, 24 females and one juvenile. Many were seen on multiple days, which corresponded in "reptile days" to 55 males, 92 females and two juveniles. Slow-worms and common lizards were only counted as "reptile days" and these corresponded to 83 and 26, respectively. For slow-worms, this comprised 25 males, 36 females, 15 juveniles and 7 sex undetermined; for common lizards this comprised four males, two females and 20 sex undetermined. The maximum day counts of slow-worms were four adult males, seven adult females, and 10 juveniles; the maximum day count of common lizards was six.

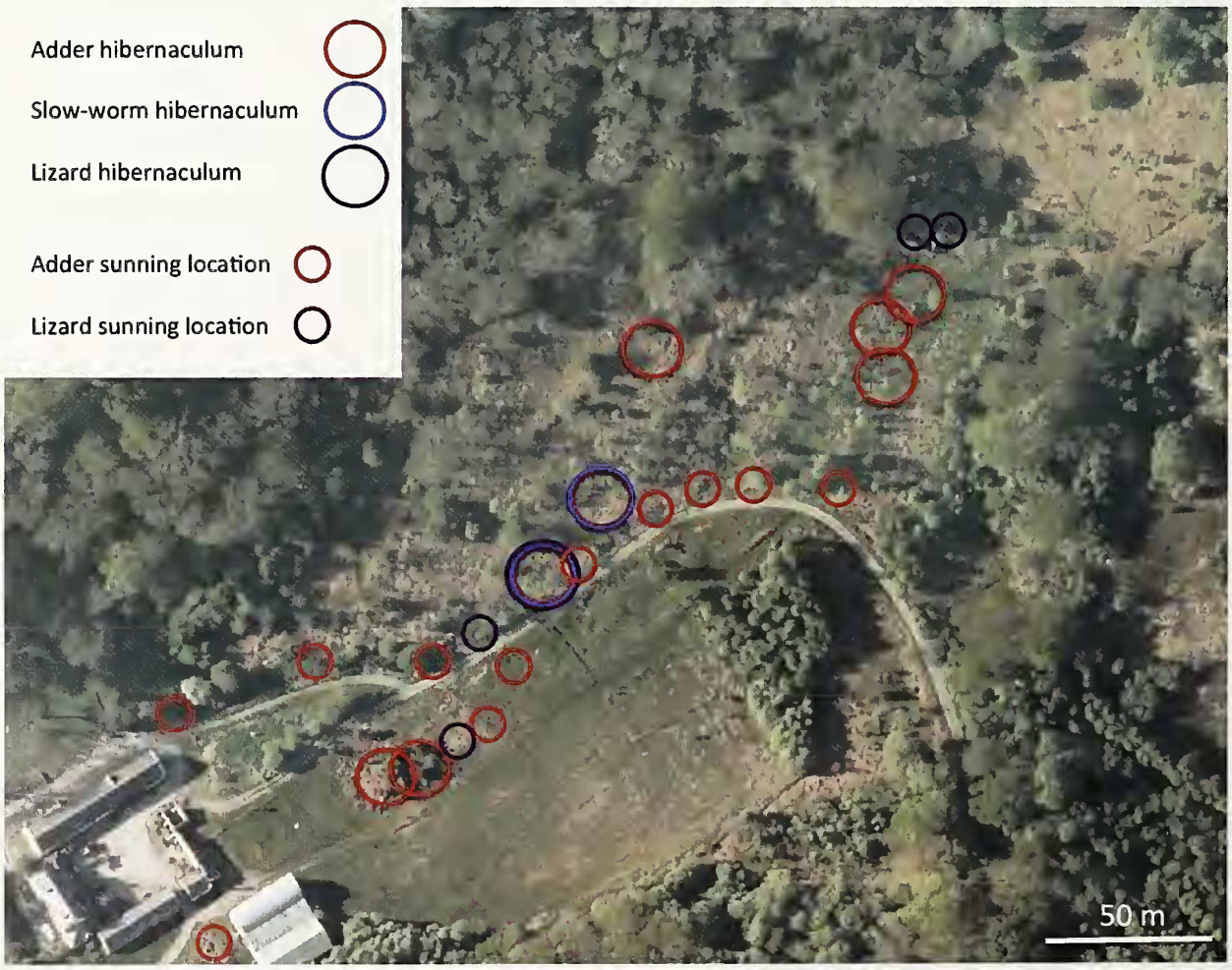

Fig. 1. Distribution of adders *Vipera berus*, slow-worms *Anguis fragilis* and common lizards *Zootoca vivipara* observed on the east shores of Loch Lomond, Scotland. This area formed only part of the total survey area at the site, but was particularly rich in reptiles.

Table 1. Numbers of adders *Vipera berus*, slow-worms *Anguis fragilis* and common lizards *Zootoca vivipara* observed during 2012 at a site on the east shores of Loch Lomond, Scotland.

	adder			slow-worm				common lizard		
	♂	♀	juv	♂	♀	juv	?	♂	♀	?
March 11								1	2	
18	3	2	1	1				2		2
22	4	3	1	1				1		
26	2	1		1						1
30	5	4		3						
31	7	4		4	1		1			6
April 1	4	2			2					
14	9	2		2	2					
15	3	2								
22		2		2	1					
28		2		1						
May 2		1		1	2					
5		2		2	3					
12		7			1					1
20		3			4					2
June 2		1		1	3					3
18	1	3					6			2
19	1	4		1	2					1
20	2	1		1	3					
July 29	2	5				10				
August 3	1	4			7					
5		4			3	2				
7	2	5				3				2
16		4			1					
24		4			1					
26		4								
30	1	3								
September 4		2		2						
12		2								
19		2								
27	1	1								
30	3	2								
October 7	2	2								
14	1	1								
21	1	1								
Total "reptile days"*	**55**	**92**	**2**	**25**	**36**	**15**	**7**	**4**	**2**	**20**
Total "estimated real"+	**15**	**24**	**1**							

- • Counts of total numbers of observations
- \+ Counts based on identification of individuals

Annual cycles

Adders

Adders were first observed on the 18 March when both males and females of various ages were found, one week after the refugia mats were placed out. This was during a period of sunny, though cool, weather with an air temperature of 12°C. Through March and early April adders would sun for long periods in locations immediately next to hibernacula, on multiple days. Up to 2-3 animals could be seen together (Fig. 2A), though typically single snakes were observed. Courtship and mating was observed in mid to late April (Fig. 2B). After this time the males and small females disappeared with only the large, mated gravid females remaining near the hibernacula (Fig. 2C). These would sun for

extended periods throughout the summer, even in cooler weather when they would flatten their bodies, to obtain maximum warmth from solar radiation (Fig. 2D), possibly to facilitate incubating gestating young (Vanning 1990). They only disappeared in early to mid September, likely to give birth, although this was not observed, and no young were found during this period. Occasionally, males would be seen through the summer period, but transiently at new locations, indicating that they were wandering. Males and small females reappeared in numbers in mid September at hibernacula, sunning for long periods, with the last seen on 21 October.

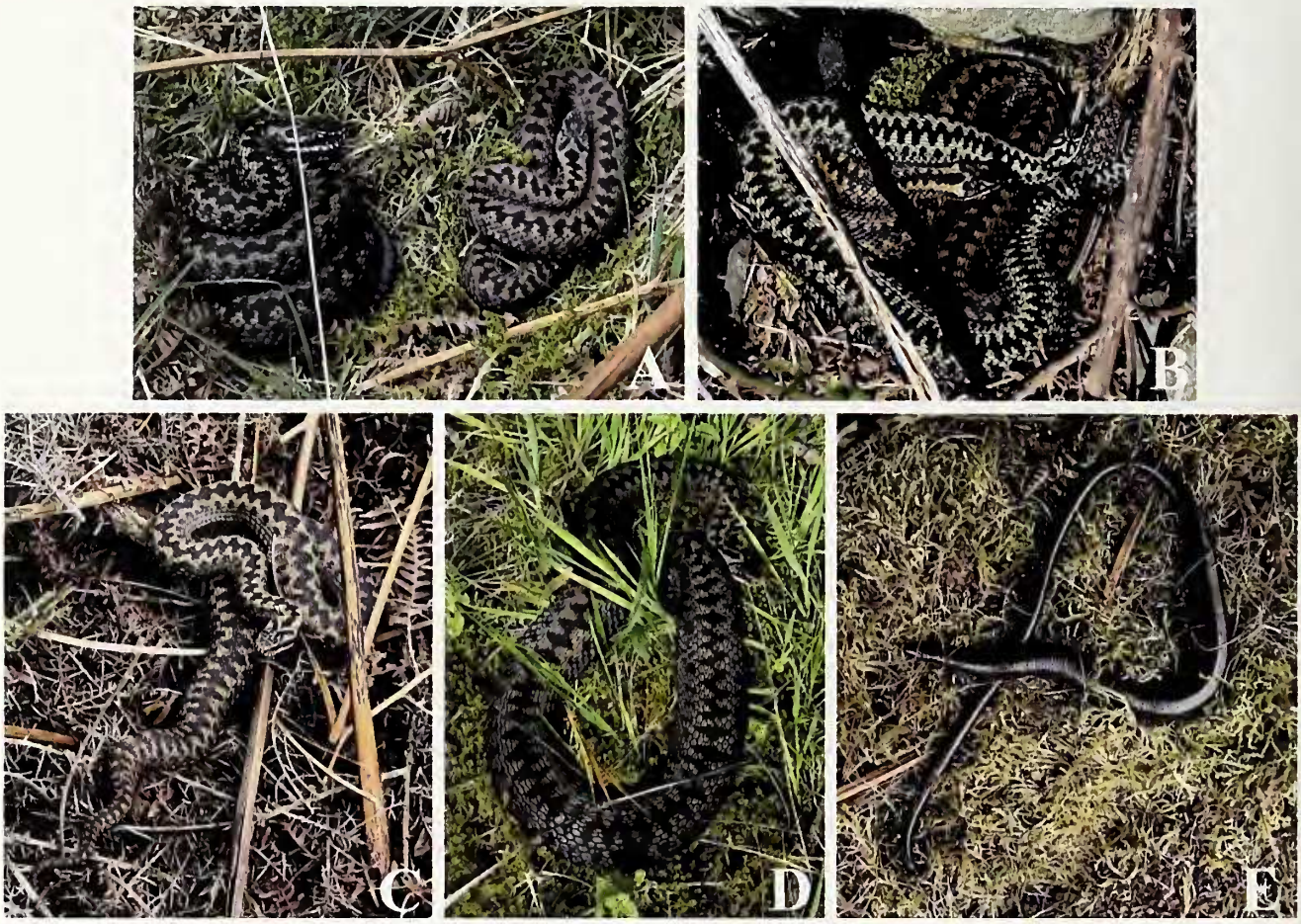

Fig. 2. a) Male and female adders *Vipera berus* (~40 cm in length), recently emerged from hibernation, 31 March 2012. b) Mating male and female adders (both ~60 cm), 15 April 2012. c) Gravid female adder (~60 cm), 22 April 2012. d) Gravid female adder (~60 cm) in a flattened posture to maximise absorbance of solar radiation, 20 June 2012. e) Gravid female slow-worm *Anguis fragilis* (~25 cm) found under a refugium mat, 25 August 2012.

Adders were found to be remarkably site faithful, with many animals seen at the same sunning positions over periods of weeks and sometimes months. Sunning positions were usually in open areas next to bracken, bramble and gorse, where snakes could retreat upon disturbance. On disturbance adders would disappear to cover, but would invariably reemerge to the same location within 10-20 minutes. Snakes were most reliably seen on sunny, warm days between 8-9 am, but later in the day if conditions were less favourable. In warm or hot conditions adders would sun for just 1-2 hours before disappearing. Adders were noticed to be the most cold tolerant of the reptiles. Some appeared on days with air temperatures barely above freezing, and hoar frost present. Generally, they were not observed to use refugia mats, apart from one gravid female through the summer, and a juvenile seen in March (Fig. 3A). This juvenile was the only young seen, and had presumably entered hibernation immediately following birth the previous autumn; it appeared to have hibernated with a male slow-worm. Ecdysis was observed on five occasions, from April to September, with four skins found. A further nine snakes were seen apparently about to undergo ecdysis, suggested by their cloudy, opaque eyes, and dark body colour.

Slow-worms

The first slow-worm was first observed on 18 March. Males were seen first, with females appearing two weeks later. Males and females were seen throughout the spring and summer, with incubating females found up to the 24 August (Fig. 2E). However, small young first appeared from mid July. Far fewer were seen through August, with the last observed on 4 September.

Slow-worms were invariably found under refugia mats. Typically they were not present at 8-9 am, but would be found at 10-11 am when the sun was on the mats, suggesting they were spending the night elsewhere and using the mat as a sunning tool. Upon disturbance, slow-worms would disappear by burrowing into the ground, but usually returned to the same place within 10-20 minutes. Many of the mats had ant Formicidae spp colonies form under them; slow-worms have been found in ants' nests elsewhere in the UK, apparently exploiting the subterranean holes created by these insects (Beebee and Griffiths, 2000). Rarely, adults were found basking above ground: these were large, gravid females in early August, with just one or two coils exposed, sometimes in groups of two or three.

Fig. 3. a) Juvenile adder *Vipera berus* (~14 cm in length), recently emerged from hibernation, found under a refugium mat, 22 March 2012. b) Common lizards *Zootoca vivipara* (~13 cm), 17 August 2012.

Common lizards

Common lizards were the first reptiles to be seen appearing on 11 March, with both males and females present. Animals were seen sunning both on refugia mats and elsewhere throughout the survey period until the 7 August, usually observed at 9-10 am on sunny days (Fig. 3B). Upon disturbance, lizards would disappear, but usually returned to the same sunning position within 10-20 minutes.

DISCUSSION

Intensive monitoring at a site at Loch Lomond has revealed a rich population of reptiles, with significant numbers of adders, slow-worms and common lizards. These high numbers reflect the apparently ideal habitat, which closely corresponds to optimum habitat described where some large populations have been observed in the UK (Avery, 1962; Prestt, 1971; Stafford, 1987; Smith, 1990; Riddell, 1996; Platenberg and Griffiths, 1999; Beebee and Griffiths, 2000; Phelps, 2004a; Phelps 2004b). For adders the activity and breeding biology of the animals observed at Loch Lomond are consistent with behaviour seen elsewhere, but particularly that reported in northern parts of Europe or at higher altitudes (Viitanen, 1967; Neumeyer, 1987; Anderssen, 2003). Breeding behavior of slow-worms and common lizards, similar to that reported here, has been noted at other places in the UK (Avery, 1962; Smith, 1990; Riddell, 1996).

In a local context this population of reptiles is significant as anecdotal evidence from casual reports to CARG (CARG 2013) suggest that it is exceptional to observe all three species together in such numbers in the Clyde area. Thus the site needs to be protected and conserved. Populations of adders studied in the UK over long periods have demonstrated that not only can individual snakes live for over two or more decades, but also that they show strong attachment to their natal areas (Phelps 2004b). Thus, such sites require long-term protection to ensure the conservation of adder populations.

In future years I plan to continue to monitor this reptile population to examine how numbers fluctuate as the habitat potentially changes through succession. This is especially important as a small hydroelectric plant is planned for construction in 2014 that crosses the area shown in Fig. 1. The survey work described in this paper has formed the basis of an environmental mitigation plan for the construction work at the site, and so continued monitoring will be required to measure its success.

ACKNOWLEDGEMENTS

I would like to thank John Sweeney for instigating the placing of the refugia mats at the survey site and for advice on reptile survey methods, and Darren O'Brien who assisted in some of the survey work. I thank *The Glasgow Naturalist* reviewer for many helpful comments that improved the paper. I also extend my thanks to the landowners for permission to survey for reptiles at this wonderful place.

REFERENCES

Anderssen, S. (2003). Hibernation habitat and seasonal activity in the adder, *Vipera berus*, north of the Arctic Circle in Sweden. *Amphibia-Reptilia* 24, 449-457.

Arnold, H.R. (1996). *Atlas of Amphibians and Reptiles in Britain*. ITE Research Publication 10. HMSO, London, UK.

Avery, R.A. (1962). Notes on the ecology of *Lacerta vivipara*. *British Journal of Herpetology* 3: 36-38.

Beebee, T.J.C. and Griffiths R.A. (2000). *Amphibians and Reptiles*. Harper Collins, London.

Benson, P.A. (1999). Identifying individual adders, *Vipera berus*, within an isolated colony in east Yorkshire. *British Herpetological Society Bulletin* 67, 21-27.

Bidie, C.I.E. (1902). Notes on the Scottish adder. *Annals Scottish Natural History* 11, 217-220.

Boulenger, G.A. (1892). An investigation into the variations of the viper in Great Britain. *Zoologist* (3) 16, 87-93.

Campbell, J. MacNaught. (1892). Supposed cannibalism in the slow-worm. *Annals Scottish Natural History* 1, 271.

CARG (Clyde Amphibian and Reptile Group) (2013). http://c-arg.webnode.com/

Dobbie, J.B. (1898a). A contribution to the avifauna of West Ross-shire. *Annals Scottish Natural History* 7, 65-75.

Dobbie, J.B. (1898b). The viper in the Pentlands. *Annals Scottish Natural History* 7, 184.

Garbett, A. (2008). Identification of individual adders *Vipera berus* by their head markings *Wyre Forest Study Group Review* 2008, 16-17. (http://www.wyreforest.net/category/articles/reptiles-and-amphibians-herpetofauna/)

Hinxman, L.W. (1902). Notes on the common adder in the Highlands. *Annals Scottish Natural History* 11, 151-153.

Lavery, C., Downie, J.R., and Livingstone S.R. (2004). Growth of Ailsa Craig slow-worms *Anguis fragilis*: Prey preference and temperature effects. *The Glasgow Naturalist* 24, 79-85.

Leighton, G. (1902). The serpents of Scotland and their study. *Annals Scottish Natural History* 11, 93-97.

McPhail, R. (2011). *The Private Life of Adders*. Merlin Unwin Books, Ludlow, UK.

McWilliam, J.M. (1925). Slow-worm on Ailsa Craig. *Scottish Naturalist* 1925: 159.

Morrison, N. (1924). The Life-Story of the Adder. Alexander Gardner, Paisley.

Neumeyer, R. (1987). Density and seasonal movements of the adder (*Vipera berus* L. 1758) in a subalpine environment. *Amphibia-Reptilia* 8, 259-276.

Phelps, T. (2004a). Population dynamics and spatial distribution of the adder *Vipera berus* in southern Dorset, England. *Mertensiella* 15, 241-258.

Phelps, T. (2004b). Beyond hypothesis – a long-term study of British snakes. *British Wildlife* 15: 319-327.

Platenberg, R.J. and Griffiths, R.A. (1999). Translocation of slow-worms (*Anguis fragilis*) as a mitigation strategy: a case study from south-east England. *Biological Conservation* 90: 125-132.

Prestt, I. (1971). An ecological study of the viper *Vipera berus* in southern Britain. *Journal of Zoology* London 164, 373-418.

Reading, C.J., Buckland, S.T., McGowan, G.M., Jayasinghe, G., Gorzula, S. and Balharry, D. (1996). The distribution and status of the adder (*Vipera berus* L) in Scotland determined from questionnaire surveys. *Journal of Biogeography* 23: 657–667.

Riddell, A. (1996). Monitoring slow-worms and common lizards, with special reference to refugia materials, refugia occupancy and individual recognition. In: *Reptile Survey Methods, English Nature Science Series No 27*, pp. 46-60. (ed. by J. Foster and & T. Gent). Peterborough, English Nature.

Service, R. (1902a). The adder in Solway. *Annals Scottish Natural History* 11, 153-162.

Service, R. (1902b). Poultry feeding on slow-worms. *Annals Scottish Natural History* 11, 253-254.

Sheldon, S. and Bradley. C. (1989). Identification of individual adders, *Vipera berus*, by their head markings. *British Journal of Herpetology* 1, 392-396.

Sheldon, S. and Bradley, C. (2011). Identifying adders by their head markings. In: *The Private Life of Adders*. McPhail, R. Merlin Unwin Books, Ludlow.

Smith, N.D. (1990). The ecology of the slow-worm (*Anguis fragilis* L) in southern England. M.Phil thesis, University of Southampton.

Stafford, P. (1987). *The Adder*. Shire Natural History No 18, Princes Risborough, UK.

Stumpel, A.H.P. (1985). Biometrical and ecological data from a Netherlands population of *Anguis fragilis* (Reptilia, Sauria, Anguidae). *Amphibia-Reptilia* 6: 181-194.

Taylor, J.M.B. (1900). The Common or Ringed Snake in Renfrewshire. *Annals Scottish Natural History* 9, 185.

Vanning, K. (1990). The thermophysiological ecology of the adder, *Vipera berus*. Dissertation, University of Nottingham, UK.

Viitanen, P. (1967). Hibernation and seasonal movements of the viper, *Vipera berus berus* (L.), in southern Finland. *Annales Zoologici Fennici* 4, 472-546.

White, F. Buchanan. (1877). Glen Tilt: its fauna and flora. *Scottish Naturalist* 4, 181-190.

Zonfrillo, B. (2000). Large slow-worm (*Anguis fragilis)* from Ailsa Craig, Ayrshire. *The Glasgow Naturalist* 23: 59